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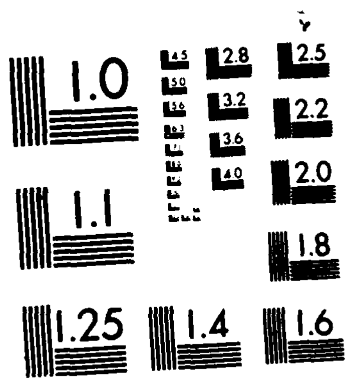

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SAFETY EVALUATION OF LOCC/ROCC (WSC-6) NAVY SHF SATELLITE COMMUNICATIONS SET

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RESEARCH AND TECHNOLOGY DEPARTMENT

4 APRIL 1984

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REPORT DOCUMENTATION PAGE

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1. REPORT NUMBER: NSWC TR 84-174	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): SAFETY EVALUATION OF LOCC/ROCC (WSC-6) NAVY SHF SATELLITE COMMUNICATIONS SET	5. TYPE OF REPORT & PERIOD COVERED
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): S. E. BUCHHOLZ, J. A. BARNES, R. F. BIS, F. C. DEBOLD, P. B. DAVIS, L. A. KOWALCHIK	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Naval Surface Weapons Center (Code R33), 10901 New Hampshire Avenue, Silver Spring, MD 20903-5000	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: OMN
11. CONTROLLING OFFICE NAME AND ADDRESS	12. REPORT DATE: 4 April 1984
	13. NUMBER OF PAGES: 25
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)	15. SECURITY CLASS. (of this report): UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

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17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Navy SHF Satellite Communications Set
Batteries
LOCC/ROCC (WSC-6)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The battery for the LOCC/ROCC (WSC-6) Navy SHF Satellite Communications Set is evaluated for use in the fleet according to NAVSEAINST 9310.1A. The following tests are performed: forced discharge, short circuit, heat tape, and charging.

S/N 0102- LF- 014- 6601

FOREWORD

This work was performed for and funded by the Naval Electronic Systems Command. The safety testing was performed on the Eagle-Picher backup memory battery for a LOCC/ROCC (WSC-6) Navy SHF satellite communications set. The testing was carried out to determine if the LOCC/ROCC (WSC-6) set was safe to ship and deploy as configured. The tests presented in this report follow the guidelines set forth in NAVSEAINST 9310.1A.

Approved by:

Jack R. Dixon

JACK R. DIXON, Head
Materials Division

CONTENTS

ILLUSTRATIONS

CHAPTER 1

INTRODUCTION

The Eagle-Picher 3V [(Li/$(CF)_x$)] Keeper battery was selected for use on a printed circuit board to function as the keep alive memory for a Navy SHF Satellite Communications Set (AN/WSC-6). The system was developed under Contract N00039-82-C-0243. The work was done in accordance with the requirements laid out in NAVSEAINST 9310.1A. The minimum requirement of nine tests were completed: three short circuit, three forced discharge, and three heat tape. Also performed were two charging tests: one on a fresh cell and one on a partially discharged cell.

CHAPTER 2

EXPERIMENTAL

Nine tests were run, three Short Circuit, three Forced Discharge, and three Heat Tape. One of each of these tests was performed on the battery outside the drawer in which it is used. Two of each of these tests were performed with the battery in the drawer (See Figure 1). In each case, the battery was on a printed circuit board (See Figure 2). To see the relative location of the battery with respect to the other circuit boards and other equipment in the mock-up drawer, refer to Figure 3. One thermocouple was placed on each side of the battery. Temperature, voltage, and current were monitored on a Fluke datalogger and recorded on a Columbia 300C. The circuits used for the short circuit test and forced discharge are shown in Figures 4 and 5, respectively.

Also, charging tests were conducted on a fresh cell as well as a partially discharged cell. The charging circuit used is shown in Figure 6. The cells were charged at 125 mA with the voltage limited to 5V.

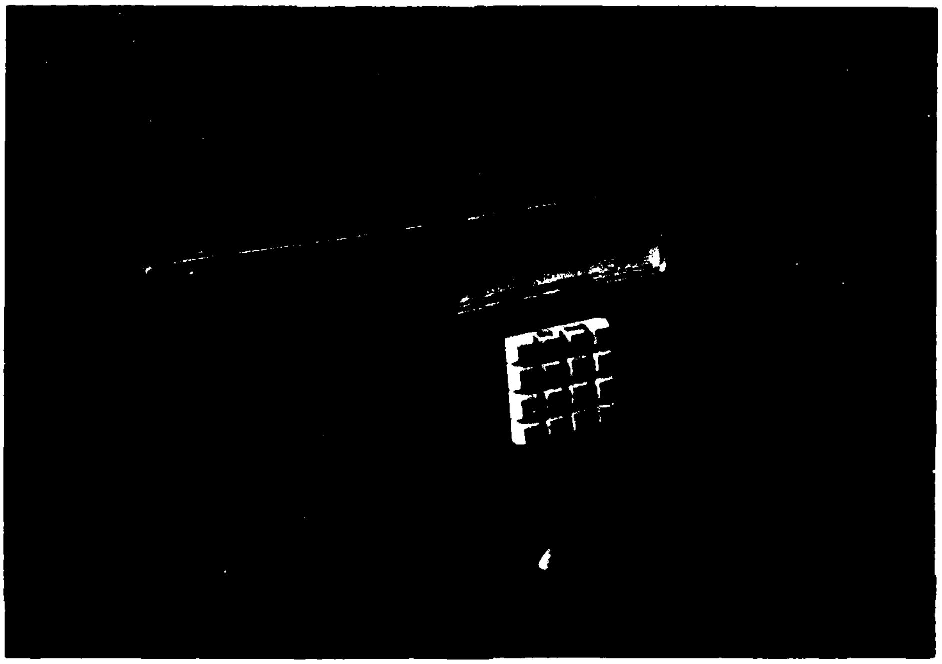

FIGURE 1. COMMUNICATIONS SET DRAWER.

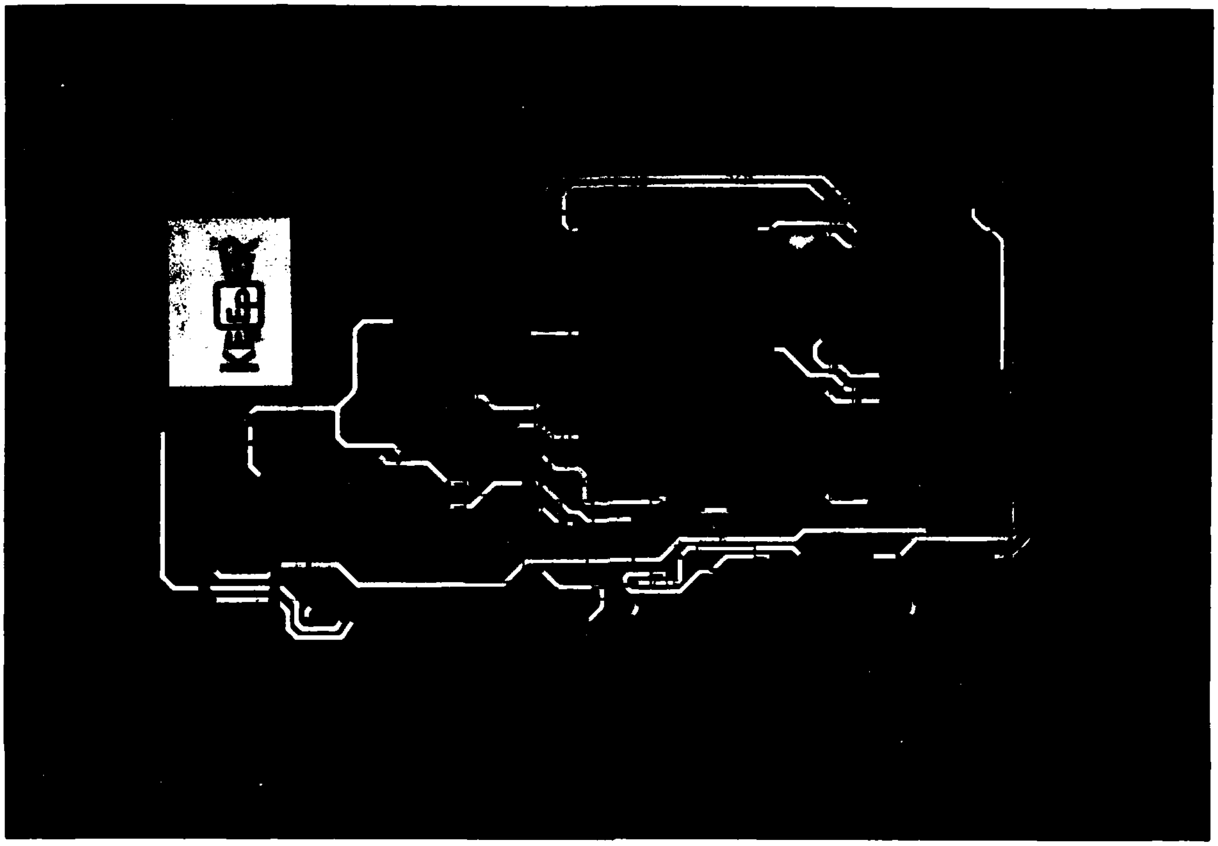

FIGURE 2. BATTERY AND CIRCUIT BOARD.

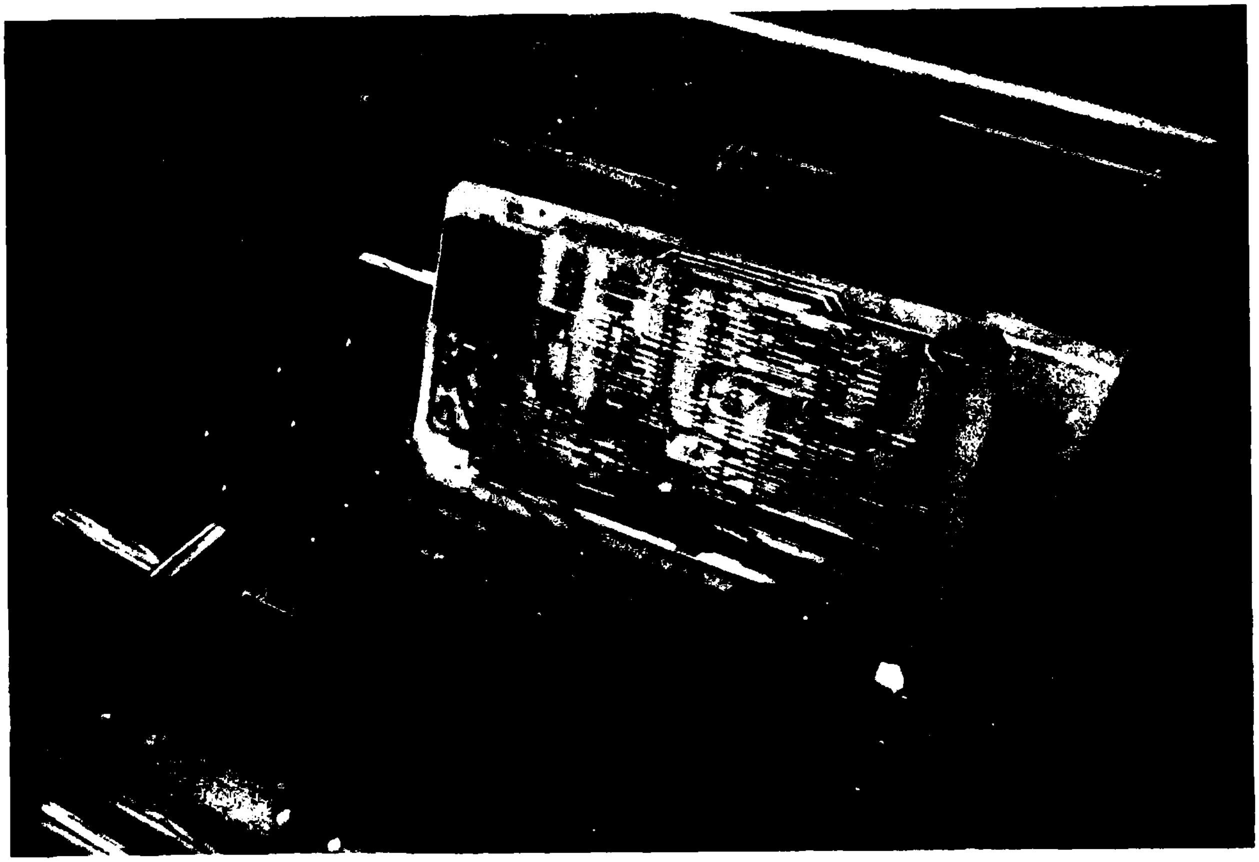

FIGURE 3. MOCK-UP OF THE INSIDE OF A COMMUNICATIONS SET DRAWER

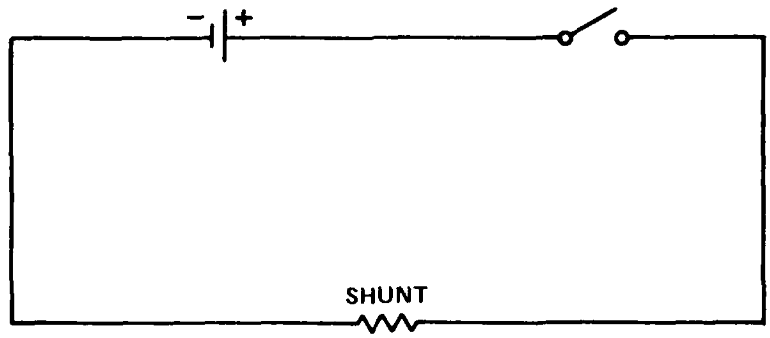

FIGURE 4. CIRCUIT DIAGRAM FOR A SHORT CIRCUIT

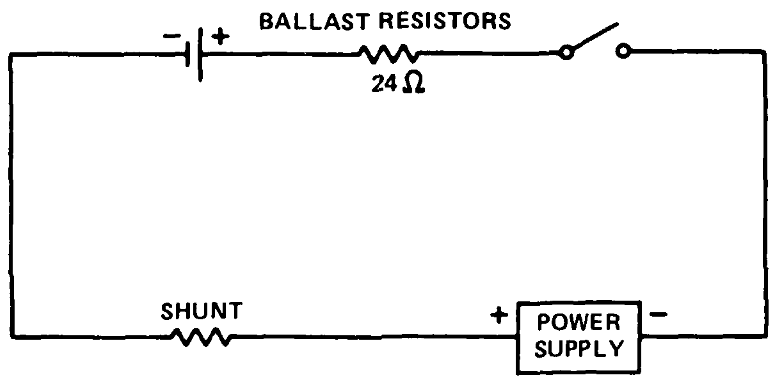

FIGURE 5. CIRCUIT DIAGRAM FOR A FORCED DISCHARGE AT 125 mA

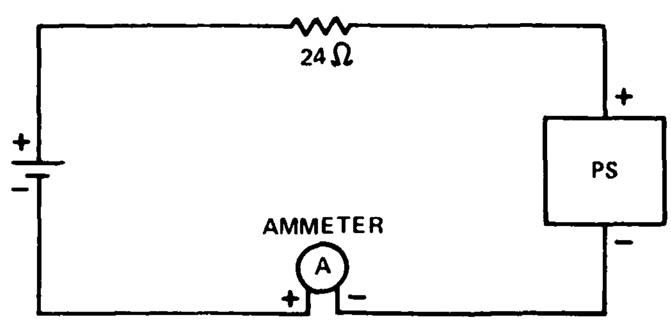

FIGURE 6. CIRCUIT DIAGRAM FOR A CHARGING CIRCUIT AT 125mA

CHAPTER 3

RESULTS

There was no significant difference between the tests run on the batteries inside or outside the unit.

In the short circuit test, the battery voltage dropped immediately to between 0.07 and 0.11 volt and continued to drop slowly. The battery heated slightly, reaching a peak temperature of between 34.4°C and 36°C. A representative graph is shown in Figure 7. No evidence of hazardous reaction or visible flame was apparent.

In the first forced discharge test, the battery voltage dropped immediately to 1.59 volts and continued to decrease slowly after that. The battery reached a peak temperature of 38.6°C seventeen minutes into the test. In the second forced discharge test, the voltage dropped immediately to 1.24 volts and continued to decrease slowly. The battery reached a peak temperature of 35.2°C eight minutes into the test. There was no reaction or flame generated during any of the three tests. A representative graph of the forced discharge tests is shown in Figure 8.

Lengths of heat tape were wrapped around the battery and around the section of the circuit board immediately behind the battery. The battery was heated at a rate of 6°C/min. Two of the batteries vented at 240°C approximately 38 minutes into the test. They vented again shortly after that. There was a relatively small amount of smoke. The third battery vented at 204°C approximately 26 minutes into the test with a relatively small amount of smoke. A graph of the test results is shown in Figure 9. A representative cell is shown in Figure 10. There were no differences between tests run on the batteries inside or outside the unit.

Without violent reaction, a fresh cell was discharged for 4 hours with a 24 Ω resistor. The battery was charged at 125 mA for 4 hours. Before the charging test began, the voltage had recovered to a value of 2.729 volts. During the charging tests, no hazardous reactions were observed. The cell was then discharged at 125 mA. The voltage decreased rapidly toward zero. The details of the charging experiment are shown in Figure 11.

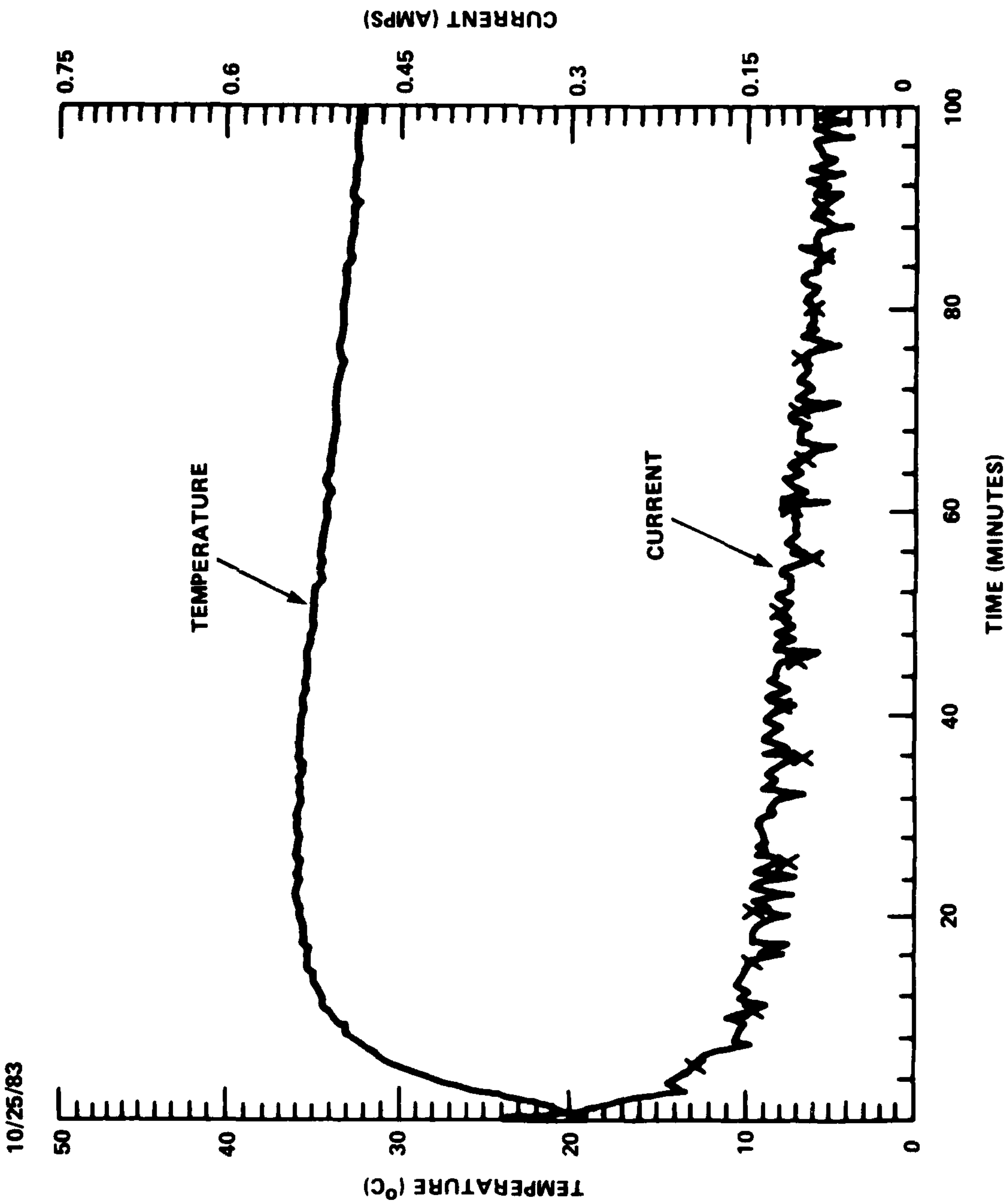

FIGURE 7. SHORT CIRCUIT

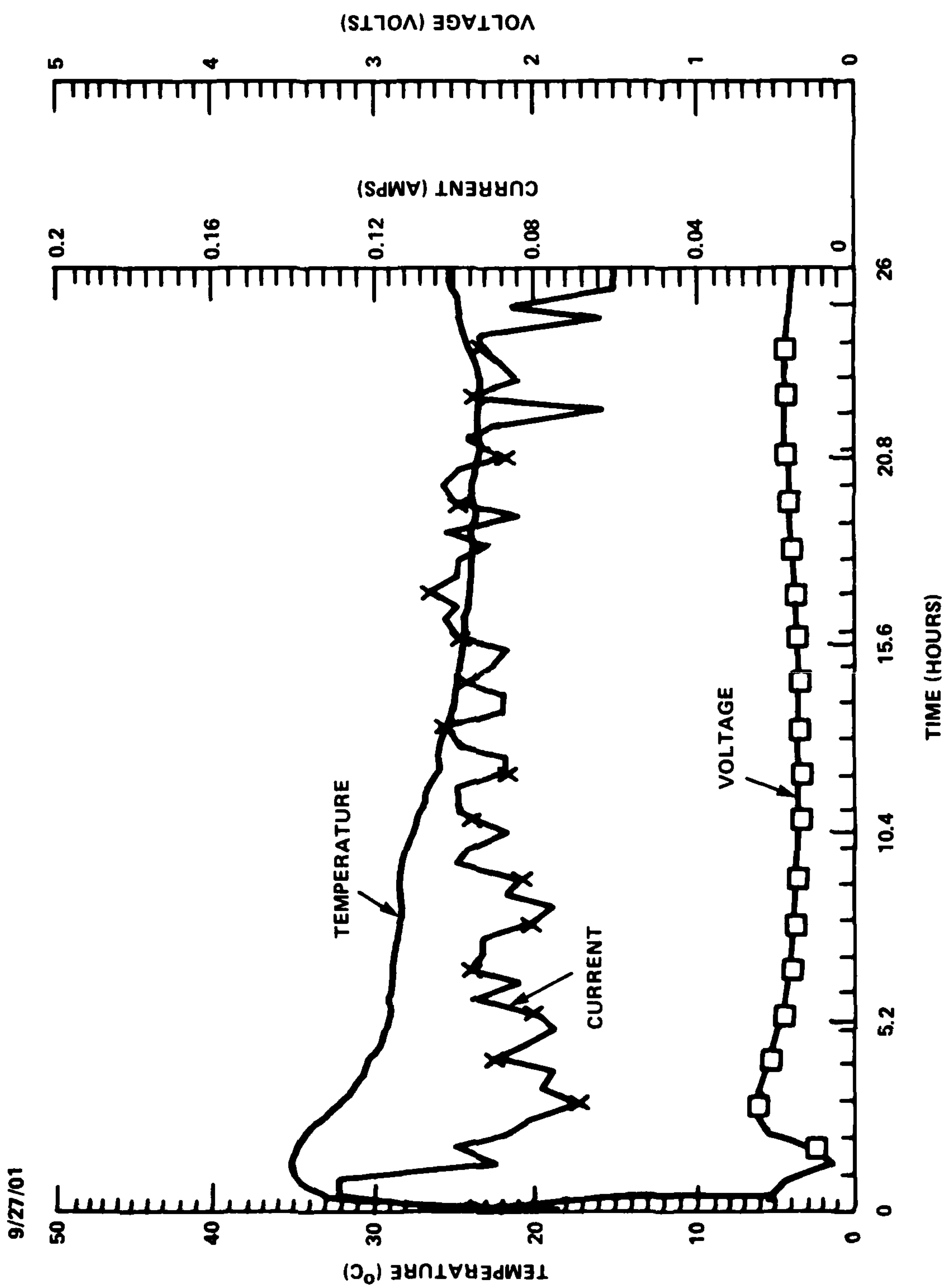

FIGURE 8. FORCED DISCHARGE WITH CASE IN COMMUNICATIONS SET DRAWER

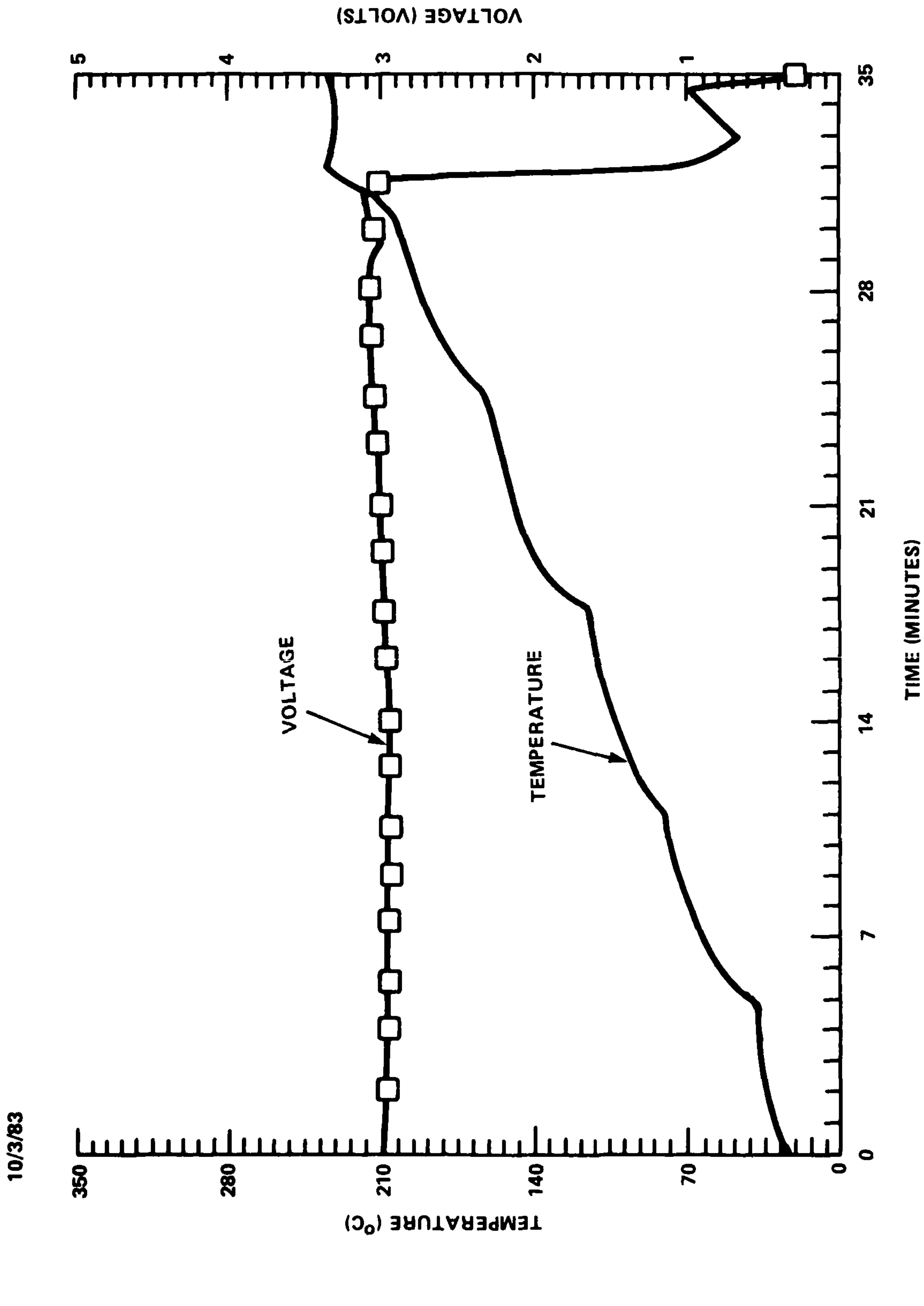

FIGURE 9. HEAT TAPE TEST

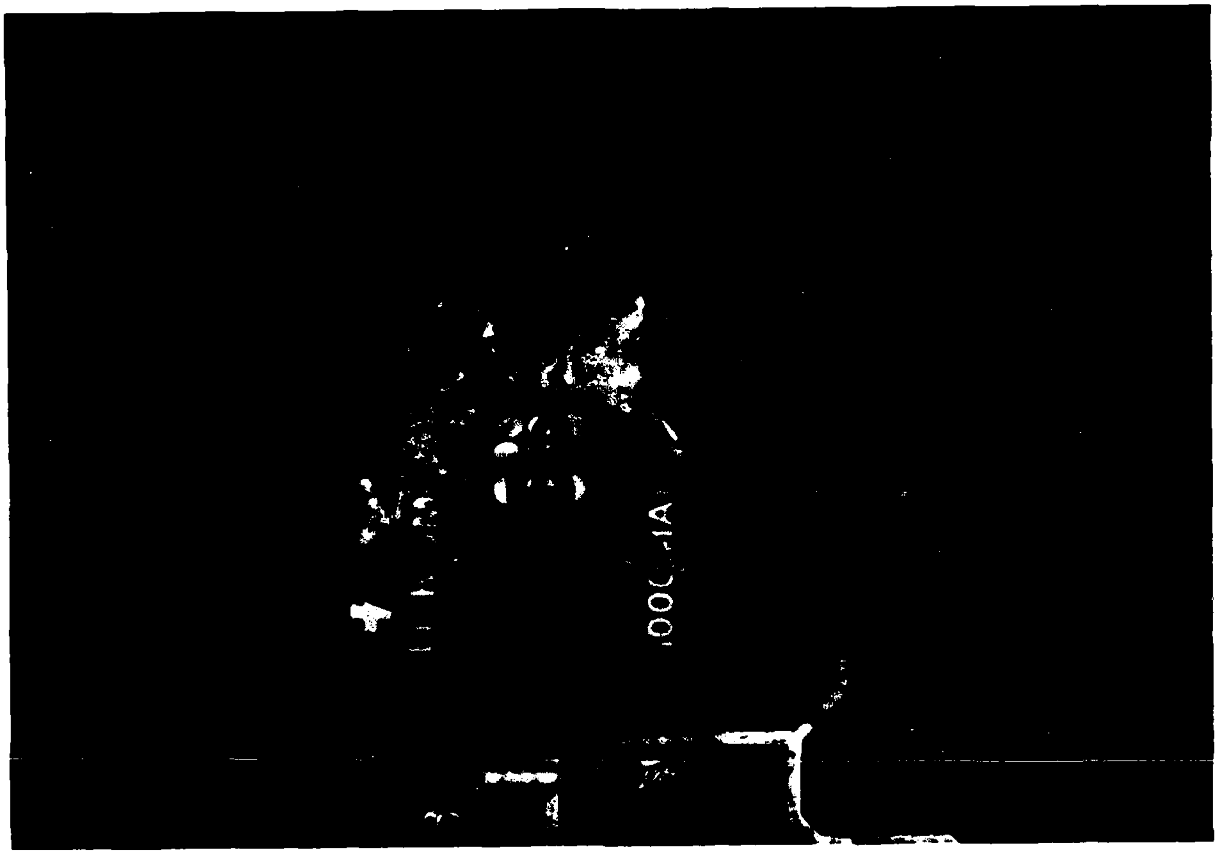

FIGURE 10. RESULTS OF HEAT TAPE TEST.

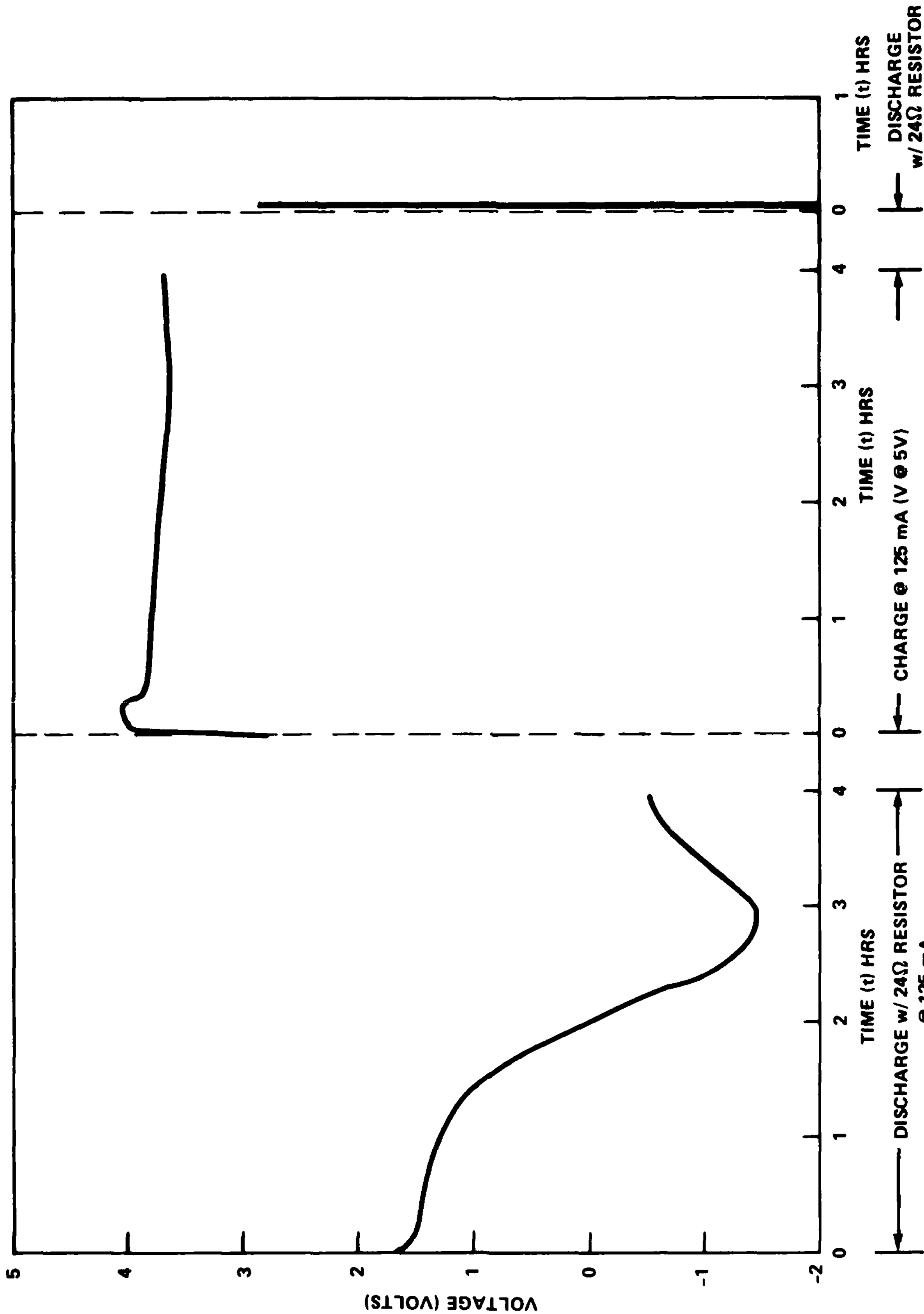

FIGURE 11. CHARGING TEST.

CHAPTER 4

CONCLUSIONS

Based on the test data discussed in this report, a recommendation for service use has been made to NAVSEA 06H. The results indicate that the Eagle-Picher 3V [$(Li/(CF)_x)$] Keeper battery is abuse-resistant under the tests conditions described here.

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